REMARKS

The present response is intended to be fully responsive to all points of rejection raised by the Examiner and is believed to place the application in condition for allowance. Favorable reconsideration and allowance of the application is respectfully requested.

Claims 1-43 are pending in this case. Claims 2-7, 11-13 are objected to. Claims 1-43 have been rejected under 35 U.S.C. § 103(a).

With respect to the Examiner's 35 U.S.C. § 103(a) rejections, Applicant has reviewed the cited art and respectfully submits that the art fails to disclose or suggest the Applicant's claimed invention. Therefore, Applicant respectfully traverses and requests favorable reconsideration.

Response to 35 U.S.C. § 103(a) Rejections

The Examiner rejected claims 1-8, 10-21, 23-34, 36-43 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,430,150 ("Azuma et al.") in view of U.S. Patent No. 5,093,824 ("Coan et al.") and further in view of U.S. Patent No. 6,198,721 ("Mueller"). Applicant respectfully submits that the prior art fails to disclose or suggest at least a method of determining a protection route comprising the steps of removing (1) all logical links from consideration that have a color other than that of the link to be protected and (2) the link to be protected and generating a restoration path only from the remaining single color logical topology. Therefore, Applicant respectfully traverses the rejections and request favorable reconsideration.

The present invention is a link based network protection path calculation mechanism. The invention is applicable to optical networks employing wave division multiplexing is applicable to any network topology such as mesh or ring network topologies. The invention can be implemented in an NMS or in the network nodes themselves.

The invention is operative to calculate a protection route that is **guaranteed** not to traverse the link it is to protect. The mechanism takes advantage of the fact that there **cannot** exist two links having the same color running over the same optical fiber. In networks with sufficient redundancy within each color (i.e. in each sub-network built of a single color there is enough redundancy such that a protection path can be found for each link), the mechanism is operative to determine the protection path by **eliminating** all colors from the logical topology of the network **except** for the color corresponding to the link to be protected. This serves to

guarantee that the protection path calculated will **not** traverse the same physical fiber as the link to be protected. Thus, the invention does **not** require or rely on the physical topology of the network. This is useful in WDM networks where the physical topology is typically **not known**.

For networks that do not have sufficient redundancy within each color and for networks that do have sufficient redundancy within each color but use bundles of optical fiber to connect nodes, the mechanism of the present invention introduces the concept of **virtual** (i.e. logical) wavelength or color whereby the logical links in use over a particular physical link are **assigned unique colors**. By default, the color of the logical link is equal to its WDM wavelength. The virtual colors assigned may be the original real color or a 'virtual' color that does not actually exist. A characteristic of the network is that within each physical link there is only **one** instance of any particular color, either real or virtual.

The protection route is either precalculated or determined dynamically on the fly using **any** suitable search algorithm, e.g., Dijkstra, BFS, DFS, etc. the choice of which is not critical to the invention. The logical topology of the network used by the search algorithm is first modified by **removing** all logical links **other than** those with the same logical color of the link to be protected. This **ensures** that the protection route will not pass through the failed physical fiber. Once the protection routes are calculated, they can be provisioned in the network by configuring the nodes accordingly.

The motivation for the invention is the desire to use conventional routing algorithms such as the Dijkstra algorithm to find a route between devices where traffic can be quickly switched to protection tunnels. In non-optical networks this is straightforward since all the paths are typically known. In WDM and DWDM optical networks, however, the problem is that core devices think there are other links available wherein a link is actually another wavelength and it will attempt to route the protection path over the failed fiber using a different wavelength. When a fiber is cut or otherwise fails, **all** links (i.e. wavelengths) associated with that fiber also fail. This occurs because the core devices typically **only have knowledge of the logical network, not the physical network**.

The application of the invention, including the technique of assigned **different (i.e. unique)** virtual colors to bundles of fiber, is that the routing software (i.e. Dijkstra) is forced to **not** route the protection path over a fiber that is in the same bundle as the fiber to be protected.

Azuma et al. teaches a telecommunication network wherein each node is provided with the same physical topology information relating to a physical construction of telecommunication paths included in the telecommunication network and with the same logical topology information relating to routing of telecommunication paths. When a failure occurs, restoration is effected by transmitting information relating to the failure that has occurred in the telecommunication network, throughout the network. Each node that receives the information relating to the failure determines alternative paths for bypassing the failure using the information relating to the failure, the physical topology information, and the logical topology information. Then service is switched to the alternative paths.

Coan et al. teaches a method for reconfiguring a telecommunications network comprising a plurality of reconfigurable cross-connect nodes interconnected by links when a failure event occurs is disclosed. The method comprises storing at each node a precomputed configuration table corresponding to each of a plurality of possible network topologies which can result from a plurality of possible failure events. After a specific failure event occurs, the network is flooded with messages so that each of the nodes is informed as to the specific existing topology of the network resulting from the specific failure event. The nodes are then reconfigurated in accordance with the precomputed configuration tables which correspond to the specific existing network topology.

Mueller teaches a method and system for data transmission in a 2-fiber ring network having a plurality of network nodes wherein working signals are bidirectionally transmitted between terminal multiplexers and add/drop multiplexers on a part of the network and wherein protection signals are bidirectionally transmitted over the other part of the network; only one wavelength being required for one working connection and one appertaining protection connection.

In connection with Figure 3, the system of Mueller teaches providing working and protection routes wherein data traffic is sent simultaneously and continuously over both routes. This is done in order to achieve fast switching of traffic and to prevent the lost data when switching to the protection route in the event of a failure of the working route. The use of the same wavelength for working and protection routes, however, is not critical according to Mueller. A cyclical interchange of the wavelengths employed is possible whereby the connection between two multiplexers can occur using different wavelengths in each transmission

direction. Given a ring with two logical connections between two pairs of terminal multiplexers as in Figure 2, the wavelength of the received working signal is then used for transmitting the protection signal. Mueller states, however, that this is more likely to result in organizational disadvantages. Thus, Mueller teaches away from the invention. See col. 4, lines 4-18.

It is submitted that regardless of the wavelengths Mueller teaches for the working and protection routes, Mueller still fails to teach a protection route calculation mechanism as taught by the present invention. Mueller, rather, teaches a method of data transmission in a 2-fiber ring network (col. 1, line 51).

It is submitted that the protection scheme of the present invention is operative to guarantee that the protection route calculation process will not generate a route over a failed link when calculating a protection route for the failed link. In other words, the link a failure occurs on **cannot** be used to protect itself. Considering an entire set of links that may fail together, such as multiple wavelengths within an optical fiber, the method of the present invention insures that the protection routes for a particular link do not pass through that same link. The method of the present invention guarantees that the same resource is not used to protect two or more logical links that fail together.

The method achieves this by analyzing the color of the logical links making up a network. First, a single color logical topology is generated by removing from consideration (1) all logical links having a color other than that of the link to be protected and (2) the link to be protected. Then, a restoration path for the link to be protected is generated using only the single color logical topology. This guarantees that the protection routes for a link will not pass through that link in the event of a failure. This feature is neither taught nor suggested by Azuma et al., Coan et al. or Mueller.

Applicant respectfully submits that the combination suggested by the Examiner fails to teach or suggest all the claims limitations. The Examiner has failed to show that one of ordinary skill in the art would have been motivated to modify Azuma et al. in view of Coan et al. and further in view of Mueller to arrive at the claimed invention because neither Azuma et al., Coan et al. nor Mueller Kang et al. teaches or suggests the present invention. Specifically, Azuma et al., Coan et al. and Mueller fail to teach or suggest generating a single color logical topology by removing from consideration (1) all logical links having a color other than that of the link to be

protected and (2) the link to be protected and then generating a restoration path for the link to be protected using only the single color logical topology.

It is believed that claims 1-8, 10-21, 23-34, 36-43 overcome the Examiner's § 103(a) rejection based on the Azuma et al., Coan et al. and Mueller references. The Examiner is respectfully requested to withdraw the rejection based on § 103(a).

Conclusion

In view of the above amendments and remarks, it is respectfully submitted that independent claims 1, 14, 27 and 40 and hence dependent claims 2-13, 15-26, 28-39, 41-43 are now in condition for allowance. Prompt notice of allowance is respectfully solicited.

In light of the Amendments and the arguments set forth above, Applicant earnestly believes that they are entitled to a letters patent, and respectively solicit the Examiner to expedite prosecution of this patent applications to issuance. Should the Examiner have any questions, the Examiner is encouraged to telephone the undersigned.

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Respectfully submitted,

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